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Standard Test Method for Performing the Sieve Analysis of Coal and Designating Coal Size[1]

This standard is issued under the fixed designation D 4749; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers procedures for determining the sieve analysis of coal and designating the size of coal from sieve analysis data. Raw as well as prepared (crushed, cleaned or screened) coals can be tested by this test method.

1.2 This test method explains how to designate coal sizes from the results of sieve analysis data in order to represent the condition of the coal as sold. In the case of special mixtures or coals with noncontinuous ranges of sizes, a sufficiently complete sieve analysis must be made to properly describe the size distribution.

1.3 This test method is not applicable for determining the sieve analysis nor for designating the size of pulverized coal.[2] Size fractions down to and including 38 μm (No. 400 U.S.A. Standard Series) can be treated by the methods discussed in this test method. Methods for handling size fractions below 38 μm (No. 400) will be developed by this committee.

1.4 The values stated in metric units shall be regarded as standard. The values shown in parentheses are provided for information only. The values stated in each system may not be exact equivalents; therefore, each system must be used independently of the other, without combining values in any way.

1.5 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 197 Method of Sampling and Fineness Test of Pulverized Coal[3]

D 346 Method of Collection and Preparation of Coke Samples for Laboratory Analysis[3]

D 388 Classification of Coals by Rank[3]

D 2013 Method of Preparing Coal Samples for Analysis[3]

D 2234 Methods for Collection of a Gross Sample of Coal[3]

D 4371 Test Method for Determining the Washability Characteristics of Coal[3]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[4]

E 323 Specification for Perforated-Plate Sieves for Testing Purposes[4]

2.2 *Other Document:*

Specification C-80 Commonwealth of Pennsylvania, Department of General Services, Bureau of Purchases, Specification for Coal:Anthracite[5]

3. Descriptions of Terms Specific to this Standard

3.1 *as-mined coal*—same as ROM coal (3.8).

3.2 *as-shipped or produced coal*—raw or prepared coal in any state or condition at which it leaves the mine property or loading facility.

3.3 *bottomsize, nominal*—the sieve designating the lower limit or bottomsize shall be that sieve of the series given in Section 6 with the largest openings through which passes a total of less than 15 % of the sample. This defined bottomsize is not to be confused with the size of the smallest particles in the lot.

NOTE 1—**Precaution:** In the case of a commercial, double-screened product, for example, 37.5 by 9.5 mm (1½ by ⅜ in.), this designation may *not* be valid. In such commercial or contractual situations, the amount of allowable material smaller than the bottomsize (for example, 9.5 mm) must be specified by the contract under which the coal is bought and sold.

3.4 *dry sieving*—for the purposes of this test method, the test method for the sieving of coal after the sample has been air-dried under prescribed conditions; this is generally used when testing with coal particles larger than 600 μm. (No. 30 U.S.A. Standard Sieve Series.)

3.5 *opening*—for the purpose of this test method, openings and apertures shall be regarded as synonomous terms. Dimensions for round and square openings shall be determined as follows: for round holes, dimensions shall refer to the opening diameter; for square holes, dimensions shall refer to the distance between parallel wires.

3.6 *prepared coal*—any coal, regardless of its topsize, that has been manually or mechanically cleaned. This includes coal that has been processed over a picking table or air tables, through a breaker, jig, or other device which segregates according to size or density (specific gravity).

3.7 *raw coal*—any coal, regardless of its topsize, that has not been manually or mechanically cleaned. Crushed coal that has not been mechanically cleaned (including coal that

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[1] This test method is under the jurisdiction of ASTM Committee D-5 on Coal and Coke and is the direct responsibility of Subcommittee D05.07 on Physical Characterization and Beneficiation of Coal and Coal Slurries.

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[2] For powdered or pulverized coal as is fired into steam boilers, refer to Method D 197.

[3] *Annual Book of ASTM Standards*, Vol 05.05.

[4] *Annual Book of ASTM Standards*, Vols 05.05 and 14.02.

[5] Available from Commonwealth of Pennsylvania, Dept. of General Services, Bureau of Purchases, 414 N. Office Building, Harrisburg, PA 17125.

has not been through a breaker which normally rejects oversize) is considered to be raw coal. Coal delivered to the surface from an underground mine is considered to be raw coal even when crushing and grinding is done underground. Coal removed from the pit of a surface mine is considered to be raw coal even when breaking and crushing facilities are provided *in the pit.*

3.8 *run-of-mine (ROM) coal*—in the case of an underground mine, it is that coal delivered to the surface by a slope belt, hoist, etc. In the case of a surface mine, it is that coal as it exists after it has been removed from the pit and placed into the initial means of transportation whether it be an on-the-road or off-the-road haul truck, dump hopper which feeds a pit-to-plant conveyor, etc. For both underground and surface mines, ROM coal is as-mined and has not been exposed to any treatment such as breaking, crushing, or cleaning except for that done by the normal operations used to extract the coal from the ground, that is, blasting, ripping, loading, cutting, etc.

3.9 *topsize, nominal*—the sieve designating the upper limit or topsize shall be that sieve of the series given in Section 6 with the smallest openings upon which is cumulatively retained a total of less than 5 % of the sample. This defined topsize is not to be confused with the size of the largest particle in the lot.

3.10 *wet sieving*—for the purposes of this test method, the test method for the sieving of coal that uses water as a medium for facilitating the segregation of the sample into particle sizes; this is generally used when testing coal particles 600 μm (No. 30 U.S.A. Standard Series) or smaller.

4. Significance and Use

4.1 This test method concerns the sieving of coal into designated size fractions for the purpose of characterizing the material as to its particle size distribution for further processing or for commercial purposes. This is covered in Part A of this standard. Raw, as well as prepared (crushed, cleaned, or screened), coals can be tested by this test method.

4.2 This test method is applicable for all types of coals, except for pulverized coals (see Method D 197) such as fed into steam boilers. Low rank coals, that is, lignites, subbituminous, and high volatile bituminous C, must be dried with caution and handled with care to minimize deterioration or size degradation during sieving.

4.3 This test method is applicable for the wet or dry-sieving of coal at sizes from 200 mm (8 in.) to 38 μm (No. 400 U.S.A. Standard). Methods for sizing materials below 38 μm are outside the scope of this test method.

NOTE 2—The sizing of material that passes the 38 μm sieve is normally performed by optical microscopy, sedimentation, centrifugation, light scattering or obfuscation, surface area measurement, or other such methods. Subsieve techniques are also used sometimes.

4.4 This test method also concerns the designation of a coal sample as to its upper (nominal top-size) and lower (nominal bottom-size) limiting sizes for the purpose of characterizing the material for further processing or for commercial purposes. This is covered in Part B of this test method. Anthracite coal is further designated by a one word descriptive term (see 14.4).

4.5 Enough material may not be collected by this test method to meet subsequent test procedures, such as washability analyses (Test Method D 4371).

PART A. SIEVE ANALYSIS OF COAL

5. Apparatus

5.1 *Sieves:*

5.1.1 *Wire Cloth Sieves:*

5.1.1.1 Standard test sieves that conform to Specification E 11 shall always be used.

5.1.1.2 For most sieve tests, where the largest particle in the sample does not exceed 25 mm (1 in.), standard 203-mm (8-in.) diameter, 50-mm (2-in.) deep sieves or sieves with larger diameters (for example 300 mm (12 in.) or 450 mm (18 in.)) are recommended. For special cases, and with small samples, 75-mm (3-in.) and 150-mm (6-in.) diameter sieves are available.

5.1.1.3 Standard test sieves shall be made from either brass or stainless steel frames and either brass, phosphor bronze, or stainless steel cloth.

5.1.1.4 In general, these square mesh sieves are used when sizing with sieves with openings smaller than 6.3 mm (¼ in.). U.S.A. Standard Sieve Designations shall be used.

5.1.1.5 For more complete details of standard test sieves, including methods of checking and calibrating the sieves, see Specification E 11.

5.1.2 *Perforated Plate Sieves:*

5.1.2.1 Perforated plate sieves, made to conform to Specification E 323, are available with square apertures from 125 mm (5 in.) to 3.36 mm (0.132 in.) and with staggered round apertures from 125 mm (5 in.) to 1 mm (0.038 in.). The sizes of successive apertures in the series follow the same ratio as in Specification E 11 for sieves.

5.1.2.2 Standard frames for perforated plate sieves with apertures 4.00 mm and larger are made of hardwood or steel to hold 300-mm (12-in.), 400-mm (16-in.), or 450-mm (18-in.) square sieve plates. For apertures smaller than 4.00 mm, 203-mm (8-in.) circular frames as well as the above larger square frames may be used.

5.1.2.3 In general, round hole sieves with staggered openings are used when sizing with sieves with opening diameters of 6.3 mm (¼ in.) or larger.

5.1.2.4 Where perforated sieves and wire cloth sieves are used in the same test (for example, in an analysis from 125 mm (5 in.) to 250 μm (No. 60)) or where results with perforated sieves are to be compared with results with wire cloth sieves, it is better to use only square aperture sieves.

NOTE 3—This action should be taken primarily while performing sieving analyses on noncommercial samples, as, for instance, in preparation plant component studies (see 6.5.1). In commerce, mixed series are still customary (see 6.1.1 and 6.3.1).

5.1.2.5 Results with a given square aperture and with the same diameter round aperture are not compatible. Therefore, all reports of sieve analysis data are incomplete without designation as to the type of sieves employed (round or square openings).

5.1.2.6 Aperture sizes of some sieves for anthracitic coal (6.3.2.1) do not conform to Specification E 323.

5.2 *Mechanical Sieve Shaker:*

5.2.1 Mechanical sieve shakers are used in practically all laboratories where frequent tests are made. They not only eliminate tedious hand labor, but, when properly used, will

produce more consistent results than hand sieving. They can, however, result in excessive sample degradation when proper precautions are not taken. Therefore it is important to establish and to monitor the sieving amplitude and the sieving time.

5.2.2 There are several general types of mechanical sieve shakers. One type is designed to simulate hand sieving by using a circular motion combined with a tapping action. This type of mechanical sieve shaker is acceptable.

5.2.3 A type of sieve shaker which will handle a stack of either round or rectangularly framed sieves and produces a vigorous agitation is especially suitable for handling large samples of coarse material. This type of mechanical sieve shaker is acceptable for handling large samples provided it is not overloaded and provided agitation time is limited so that degradation of the coal being sieved does not occur (see 11.3.5).

NOTE 4—Some manufacturers can supply machines with reduced amplitude of vibration or variable speeds, or both, for soft materials.

5.2.4 Mechanical sieve shakers can generally be classified into two types: batch (acceptable) and continuous (unacceptable).

5.2.4.1 *Batch*—Batch mechanical sieve shakers are those in which a controlled quantity of coal is placed into the apparatus and mechanical action is initiated. After a controlled time period, mechanical action is completed and the size fractions are removed from the horizontal sieves. These types of mechanical sieve shakers are acceptable.

5.2.4.2 *Continuous*—Continuous mechanical sieve shakers are unacceptable for the purpose of this test method. Continuous mechanical sieve shakers are those in which a continuous stream of coal is fed into the apparatus and over a set of inclined sieves. The retention time on these sieves depends upon the degree of inclination, the throw of the sieves, and the frequency of mechanical action. The various size fractions are collected in individual containers in a continuous stream.

6. Standard Series of Sieves

6.1 *Crushed Bituminous, Subbituminous, and Lignitic Coals:*

6.1.1 For crushed bituminous, subbituminous, and lignitic coals, the standard series of sieves shall utilize round-hole perforated plate sieves for sieves with opening diameters of 6.3 mm (¼ in.) or larger and wire-cloth (U.S.A. Standard) sieves with square openings for sieves with openings smaller than 6.3 mm (¼ in.).

TABLE 1 Size Designation, Anthracitic Coal

Size	Size of Round-Hole Openings in Testing Sieves, mm (in.)	
	Passing	Retained On
Egg	83 (3¼)[A]	62 (2⁷⁄₁₆)
Stove	62 (2⁷⁄₁₆)	41 (1⅝)
Chestnut	41 (1⅝)	21 (¹³⁄₁₆)
Pea	21 (¹³⁄₁₆)	14 (⁹⁄₁₆)
Buckwheat №1	14 (⁹⁄₁₆)	8 (⁵⁄₁₆)[A]
Buckwheat №2 (Rice)	8 (⁵⁄₁₆)[A]	4.8 (³⁄₁₆)[A]
Buckwheat №3 (Barley)	4.8 (³⁄₁₆)[A]	2.4 (³⁄₃₂)
Buckwheat №4	2.4 (³⁄₃₂)	1.2 (³⁄₆₄)

[A] Listed in Specification E 323, Table 1.

6.1.2 For the purpose of simplifying communication between concerned parties, the following series of sieves shall be considered as the standard series for crushed bituminous, subbituminous and lignitic coals:

Round Hole Perforated Plate Sieves

200 mm (8 in.)	37.5 mm (1½ in.)
150 mm (6 in.)	31.5 mm (1¼ in.)
125 mm (5 in.)	25.0 mm (1 in.)
100 mm (4 in.)	19.0 mm (¾ in.)
75 mm (3 in.)	12.5 mm (½ in.)
63 mm (2½ in.)	9.5 mm (⅜ in.)
50 mm (2 in.)	6.3 mm (¼ in.)

Wire Cloth (U.S.A. Standard) Sieves with Square Openings

4.75 mm (No. 4)	300 μm (No. 50)
2.36 mm (No. 8)	150 μm (No. 100)
1.18 mm (No. 16)	75 μm (No. 200)
600 μm (No. 30)	38 μm (No. 400)

6.1.3 For crushed bituminous, subbituminous, and lignitic coals, an alternate standard series of sieves can utilize square-hole perforated plate or steel-wire sieves for sieves with openings of 6.3 mm (¼ in.) or larger and wire cloth (U.S.A. Standard) sieves for sieves with openings smaller than 6.3 mm (¼ in.). This alternate series shall use sieves with openings of the same dimensions as those given in 6.1.2. When this alternate series of square openings is used, the report must include this information.

6.1.3.1 Since round hole 6.3-mm (¼-in.) perforated plate sieves produce undersize of approximately the same amount as 4.75-mm (No. 4 U.S.A. Standard) wire cloth sieves, that is, these sieves are nearly equivalent, it is not necessary to utilize both 6.3-mm (¼ in. round) perforated plate and 4.75-mm (No. 4 U.S.A. Standard) wire cloth sieves simultaneously. The selection of either will be sufficient.

6.2 *Coal Used as Coke Oven Charge:*

6.2.1 For coal that will be used as a coke oven charge, the standard series of sieves shall utilize square-hole perforated plate or steel-wire sieves with openings of 6.3 mm (¼ in.) or larger and wire cloth (U.S.A. Standard) sieves for sieves with openings smaller than 6.3 mm (¼ in.).

6.2.1.1 Typical coke oven charge is 80 % minus 3.2 mm (⅛ in. round). For the purpose of identifying compliance with this criteria of 80 % passing ⅛ in. round, it should not be necessary to use sieves larger than 4.75 mm (No. 4 U.S.A. Standard). To designate the topsize of this charge according to Part B of this test method (Section 14), it may be necessary to use larger sieves. It is recommended that sieving be done initially at 4.75 mm (No. 4 U.S.A. Standard), then progressively sieve the oversize through the next larger sieve until the 5 % criteria of 4.8 is met.

6.2.2 For the purpose of simplifying communication between concerned parties, the following series of sieves shall be considered as the standard series for coal that will be used as a coke oven charge:

Square Hole Perforated Plate Sieves

50.0 mm (2 in.)
37.5 mm (1½ in.)
25.0 mm (1 in.)
19.0 mm (¾ in.)
12.5 mm (½ in.)
9.5 mm (⅜ in.)
6.3 mm (¼ in.)

6.2.2.1 Smaller sizes shall conform to specifications for wire-cloth sieves (U.S.A. Standard) with square openings, and are the same as those in 6.1.2.

6.3 *Anthracitic Coal:*

6.3.1 For anthracitic coal, the standard series of sieves shall utilize round-hole perforated plate sieves.

6.3.1.1 Sieve plates mounted in hardwood or steel box frames 40.6 to 50.8 cm (16 to 20 in.) square are satisfactory for testing chestnut, pea, and buckwheat sizes of anthracitic coal. For egg and stove sizes (see Table 1), it is more convenient to use sieves with frames that are square or rectangular in shape having an area of 0.37 to 0.56 m^2 (4 to 6 ft^2).

6.3.2 For the purpose of simplifying communication between concerned parties, the following series of sieves shall be considered as the standard series for anthracitic coal:

Round Hole Perforated Plate Sieves

83 mm (3¼ in.)
76 mm (3 in.)[A]
62 mm (2 7/16 in.)
41 mm (1⅝ in.)
21 mm (13/16 in.)
14 mm (9/16 in.)
8 mm (5/16 in.)[A]
4.8 mm (3/16 in.)[A]
2.4 mm (3/32 in.)
1.2 mm (3/64 in.)

[A] Listed in Specification E 323.

6.3.2.1 These standard anthracitic coal sieve sizes are those specified by Commonwealth of Pennsylvania Specification C 80.

6.4 *Additional Sieves*—Additional sieves are required if a discontinuity(ies) or deviation(s), or both, from a normal gradation of sizes is (are) found. For sieves below 6.3 mm (¼ in.), additional wire-cloth sieves can be selected from Table 1 of Specification E 11. For sieves above 6.3 mm (¼ in.), additional round or square hole perforated plate sieves may be selected from Table 1 of Specification E 323.

6.5 *Other Shapes*—Other opening shapes can more fully characterize the coal (oval, rectangular, etc.). They shall only be used by agreement between the concerned parties.

6.5.1 The use of round hole sieves in plant sizing operations has been a common practice and much data has been established. However, newer plants, most coking operations, and mathematical treatment of comminution studies use the square hole sieves. For comparison purposes, round hole openings may be calculated to an approximation of the square opening in accordance with the following formula:

$$\frac{\text{round opening, mm}}{1.25} = \text{square opening, mm}$$

6.5.1.1 Due to differences in particle shape peculiar to individual coal types, 1.25 is not always the best factor to use when converting between round hole and square hole openings. The normal range for this factor varies from 1.17 to 1.26. It is best to determine this conversion factor for any coal in question by determining the sieve analysis alternatively using first round and then square openings.

6.5.1.2 When specifying preparation plant components that utilize wire mesh, Tyler mesh designations are often used rather than U.S.A. Standard. Table 2 shows the comparison of Tyler mesh designations with the U.S.A. Standard designation based on the aperture sizes of each type. U.S.A. Standard Series designations shall always be used. Tyler mesh designations are also to be given where necessary for clarity.

TABLE 2 Comparison Table of U.S.A. Standard with Tyler Sieve Series

U.S.A. Standard Series		Tyler
Standard	Alternate	
5.60 mm	No. 3½	3½ mesh
4.75 mm	No. 4	4 mesh
4.00 mm	No. 5	5 mesh
3.35 mm	No. 6	6 mesh
2.80 mm	No. 7	7 mesh
2.36 mm	No. 8	8 mesh
2.00 mm	No. 10	9 mesh
1.70 mm	No. 12	10 mesh
1.40 mm	No. 14	12 mesh
1.18 mm	No. 16	14 mesh
1.00 mm	No. 18	16 mesh
850 µm	No. 20	20 mesh
710 µm	No. 25	24 mesh
600 µm	No. 30	28 mesh
500 µm	No. 35	32 mesh
425 µm	No. 40	35 mesh
355 µm	No. 45	42 mesh
300 µm	No. 50	48 mesh
250 µm	No. 60	60 mesh
212 µm	No. 70	65 mesh
180 µm	No. 80	80 mesh
150 µm	No. 100	100 mesh
125 µm	No. 120	115 mesh
106 µm	No. 140	150 mesh
90 µm	No. 170	170 mesh
75 µm	No. 200	200 mesh
63 µm	No. 230	250 mesh
53 µm	No. 270	270 mesh
45 µm	No. 325	325 mesh
38 µm	No. 400	400 mesh

6.6 Frames conforming to criteria in Specification E 11 or Specification E 323 shall be used with applicable sieves.

6.7 Suitable pans and covers as applicable to fit specific sieves shall be used as required by Specification E 11 or Specification E 323.

7. Gross Sample

7.1 Collect the gross sample in accordance with the principles of Methods D 2234.

NOTE 5—ASTM methods for collection of gross samples from stockpiles, cartops, etc. (stationary sampling) are being developed. When these methods are available, application of those standards will be required for stationary sampling.

7.2 Accurate sampling is of the greatest importance and is the basic requirement for reliable sieve analyses. Take great care to obtain samples that are representative of the batch or lot being tested. The greatest cause of inconsistencies in test results is improper sampling that does not represent the material being tested. Therefore, once a sampling procedure has been established, this same procedure is followed during subsequent sampling.

7.3 The quantity or mass of a gross sample will depend on the character of the material and the form in which it is available and also on whether the test is to determine the particle size distribution of a pile, batch, shipment, day's production, or a short span of time for production control.

The range of quantity or mass of a gross sample can be as much as several thousand kilograms or it may be as little as a fraction of a kilogram.

7.4 Collect increments regularly and systematically, so that the entire quantity of coal sampled will be represented proportionately in the gross sample, and with such frequency that a gross sample of the required amount shall be collected. Collect not less than the number of increments specified in Table 2 of Methods D 2234.

7.5 When the coal is passing over a conveyor or through a chute, take increments which include the full width and thickness of the stream of coal, either by stopping the conveyor and removing all coal from a transverse section of it, or by momentarily inserting a suitable container into the stream and withdrawing the sample. When it is impracticable to collect increments the full width and thickness of the coal stream, collect the increments systematically from all portions of the stream.

7.6 The method of collection of the gross sample shall be such as to produce a minimum of degradation.

7.7 The probability of collecting representative portions (samples) for sieve analysis is less from the surface of coal in piles or from loaded cars or bins than from a moving stream of coal. Where possible, sample such that the full volume of coal in the lot being sampled is represented in the final sample.

8. Weight of Gross Sample

8.1 The weight of the gross sample collected shall conform to the general principles of Methods D 2234. Usually the minimum masses to be collected are those given in Table 3. For lots of coal greater than 10 000 tons, the interested parties shall agree on the method to be used for collection and division of the gross sample prior to sieve analysis. In such cases, the following information shall be included on the analysis report:

8.1.1 Total weight of lot sampled.

8.1.2 Number of sampling increments taken.

8.1.3 Total weight of sample taken.

NOTE 6—**Precaution:** Enough material may not be collected by this method to meet subsequent test procedures, such as determining the washability characteristics of coal (Test Method D 4371). See the weight required by proposed subsequent test methods prior to sampling for the sieve analysis.

TABLE 3 Gross Sample Quantity to be Collected for Crushed Coals Other than Anthracitic Coal[A]

Type of Coal	Minimum Mass Required
Run-of-mine-coal	Not less than 1800 kg (4000 lb)
Screened coal with upper limit larger than 100 mm (4 in.) round	Not less than 1800 kg (4000 lb)
Coal smaller than 100 mm (4 in.) round	Not less than 900 kg (2000 lb)
Coal smaller than 50 mm (2 in.) round	Not less than 450 kg (1000 lb)
Coal smaller than 25 mm (1 in.) round	Not less than 215 kg (500 lb)
Coal smaller than 12.5 mm (½ in.) round	Not less than 45 kg (100 lb)
Coal smaller than 2.36 mm (No. 8 mesh, U.S.A. Standard)	Not less than 4.5 kg (10 lb)
Coal smaller than 600 μm (No. 30 mesh, U.S.A. Standard)	Not less than 0.5 kg (1 lb).

[A] For anthracitic coal, see 9.4.

9. Preparation and Division of Gross Sample into Test Sample for Sieving

9.1 When necessary for proper handling and division, air-dry the gross sample in accordance with Method D 2013.

9.2 In order to divide the gross sample into test samples, do sample division in accordance with the procedures outlined in Method D 2013 or Method D 2234.

NOTE 7—**Precaution:** Never reduce the topsize of a sample to be used for size analysis, that is, decreasing the quantity of a sample is allowed as long as the remaining portion is representative of the material sampled, but reduction in topsize is never allowed.

9.3 Samples may be divided according to the following schedule:

9.3.1 *Coal Larger than 25 mm (1 in.) Round*—Sieve without mixing or dividing.

9.3.2 *Coal Smaller than 25 mm (1 in.) Round*—Divide in amount to not less than 56.6 kg (125 lb) by riffling or by arranging the sample in a long, flat pile and successively halving it or quartering it by the alternate-shovel method as follows: Starting at one end of the long pile, take successive shovelfuls from the long pile using a flat, straight-edged shovel (advancing a distance equal to the width of the shovel for each shovelful), and retain alternate shovelfuls or every fourth shovelful for the sample (see Plate 1 of Method D 346).

9.3.3 *Coal Smaller than 12.5 mm (½ in.) Round*—Divide to not less than 11.4 kg (25 lb) by passing it through a riffle or equally accurate dividing device, or by the alternate-shovel method as described in 9.3.2.

9.3.4 *Coal Smaller than 4.75 mm (No. 4) Sieve*—Divide to not less than 1000 g (2 lb) by riffling.

9.3.5 *Coal Smaller than 2.36 mm (No. 8) Sieve*—Divide to not less than 500 g (1 lb) by riffling.

9.4 For anthracitic coal, the laboratory samples for sieving shall consist of the following approximate minimum amounts:

Sample Quantity: Anthracitic Coal

Size (see Table 1)	Laboratory Sample Approximate Minimum Mass, kg (lb)
pea	22.7 (50)
buckwheat №1	11.3 (25)
buckwheat №2 (rice)	4.5 (10)

9.4.1 For sizes larger than pea, use Table 3.

9.4.2 For sizes smaller than buckwheat # 2 (rice) use Table 3.

10. Sample Preparation

10.1 When the test sample is not dry and free flowing because of moisture, dry in accordance with Method D 2013. The air drying apparatus shall conform to Method D 2013. For air-drying ovens, drying temperatures shall be maintained at 10 to 15°C (18 to 27°F) above room temperature with a maximum temperature of 40°C (104°F), unless ambient temperature is above 40°C (104°F) in which case ambient temperature shall be used.

10.1.1 Sufficient dryness for bituminous coals has been found to be that point during the drying process when all apparent wetness is gone and when dust appears when representative portions of the coal are dropped from a height of 150 mm (about 6 in.).

10.1.2 Where the temperature in 10.1 might have some adverse effect on the material, dry and handle with caution samples of low rank coal (for example, lignite, subbituminous, and high volatile C bituminous) (see Classification D 388) to prevent degradation during sieving. Normally, the criteria given in 10.1.1 for air drying of bituminous coals is also acceptable for subbituminous coals.

10.2 In general, sieve air-dried material; however when difficulty is encountered in obtaining reproducible results on materials difficult to sieve, particularly finer coal, and when the material is not physically altered in water, accurate sieving may be made by the wet method.

10.3 When necessary, do sample division in accordance with the procedures outlined in Method D 2013 or Method D 2234.

10.4 When subsequent testing or analysis, or both, is required, use careful judgement to ensure that sufficient material is present in all fractions.

11. Procedure

11.1 *General Considerations:*

11.1.1 Accurately weigh the test sample before sieving. Weigh with a precision equal to or better than 0.5 % of the fraction being weighed.

11.1.2 Start with the sieve having the largest required aperture (for an exception see 11.1.8).

11.1.3 Limit the portion of coal used for each sieving so that all coal particles will be in direct contact with the aperture at the completion of sieving on each successive sieve.

11.1.4 Sieve until all portions of the sample are used. Combine all separately sieved material representing a particular size-fraction but obtained from sieving separate portions of the same sample.

11.1.5 Whenever sieving through a series of sieves and the larger particles have been sieved from the test sample and the weight of the smaller sieve fraction(s) exceeds the weight for that fraction(s) as given in 9.3, it is permissible to divide the remaining portion of the test sample (the smaller sieve sizes) to not less than that weight given in 9.3 before sieving at the smaller sieve sizes.

11.1.6 Continue sieving with successive sieves having the desired size apertures until the sieve having the smallest desired size aperture is used.

11.1.7 Sieving can be done by grouping sieves having the desired size apertures, thus accomplishing the sieving in one operation known as nesting.

11.1.8 When utilizing smaller mesh sieves, especially when wet-sieving, use the smallest sieve first in order to remove clays and other extremely small materials that may blind and clog the larger mesh sieves, that is, when both 150 μm (No. 100) and 75 μm (No. 200) sieves are used, use the latter first in order to facilitate sieving. Additionally, where larger particles are present that can adversely affect the size of the sieve openings, use a cover sieve (protective sieve of a larger mesh) to keep coarse particles off the finer sieves.

11.1.9 Where possible, use sieve covers on sieve apparatus to limit dust and particle loss.

11.1.10 Weigh each size fraction of sieved coal with a precision equal to or better than 0.5 % of the fraction being weighed.

11.1.11 Note that the objective of shaking, either manually or mechanically, is to place all of the pieces of a given size on the appropriate sieve and to avoid size degradation. Coal particles greater than 600 μm (No. 30) are particularly susceptible to attrition; therefore, avoid excessive sieving time and amplitude (see 11.3.5).

11.2 *Hand Sieving:*

11.2.1 Hand sieve with a reciprocating, horizontal motion so that a particle travels over a distance of not more than 200 mm (about 8 in.). The maximum particle travel distance shall be 100 mm (4 in.) or less for 203-mm (8-in.) diameter sieves and 37.5 mm (1.5 in.) or less for 75-mm (3-in.) diameter sieves. Take care to prevent any of the coal particles from fracturing upon impact with the sieve frame or with other coal particles.

11.2.2 Manual (hand) sieving is performed slightly differently depending on the size of the coal particles.

11.2.3 *For Coal Larger than 63 mm (2½ in.) Round*—Manipulate pieces of coal not passing readily through sieves 63-mm (2½-in.) round and larger to see if they will pass through the opening in any position. Do not shake sieves 63-mm (2½-in.) round and larger except for whatever jiggling may be necessary to clear the sieves of fine coal.

11.2.4 *For Coal Smaller than 63 mm (2½ in.) Round but Larger than 6.3 mm (¼ in.) Round*—Test coal passing the 63-mm (2½-in.) round sieve with sieves down to and including 6.3-mm (¼-in.) round as follows: Move the sieve horizontally a distance of about 200 mm (8 in.) at just a sufficient rate to cause the pieces of coal to tumble or roll on the sieve. Stop the motion of the sieve without impact. After ten such shakes (five in each direction), sieving of the increment is complete.

11.2.5 *For Coal Particles Smaller than 6.3-mm (¼-in.) Round*—Use wire cloth sieves with square openings (see Table 1). Place the test sample on a clean dry sieve with the pan attached. Make, or at least complete, the test on one sieve at a time (11.2.7). While holding the uncovered sieve and pan in both hands, sieve with a gentle rotary motion until most of the finer material has passed through and the residue looks fairly free of finer particles. This operation usually takes only 1 or 2 min for sieves coarser than 150 μm (No. 100) and 3 or 4 min for sieves 150 μm (No. 100) and finer.

11.2.5.1 When the residue appears to be free of finer particles, replace the cover on the sieve, then carefully separate the sieve from the pan. Place the sieve onto a second pan that is clean and dry. Temporarily cover and move the original pan with contents aside. Hold the sieve, cover and pan firmly, turn the assembly upside down on the table, and remove the pan. Then, with the sieve and cover inverted and held firmly in one hand, gently tap the side of the sieve with the handle of the brush used for cleaning sieves. Dust adhering to the sieve and particles in the mesh will be dislodged by this action. Brush the underside of the sieve.

NOTE 8—**Precaution:** Particles could be lost while inverting the sieve or be trapped or broken. As an alternate procedure, the underside can be brushed by tilting the sieve to about a 30° angle.

11.2.5.2 Replace the empty pan onto the sieve and restore the assembly to an upright position. Tap the cover lightly and carefully remove the cover. Replace onto the sieve any coarse material remaining in the cover. Set the cover aside.